Chapter 6

# Food Access and Stability

**Key Chapter Findings**

- Climate and weather have demonstrable effects on food prices, and consequently food access and its stability.
- Food access is influenced by multiple factors, both inside and outside the food system; within the food system, trade and wholesaling/retailing of food each act to alter food access and stability, and are sensitive to changing climate factors.
- The adaptive capacity of food access to changes in climate is potentially very high but varies enormously between high-income and low-income countries and individuals, and between urban and rural populations.

Food access addresses the question "If food exists (i.e., is available), can you get it?" This chapter defines food access, relates it to important components of the food system, and identifies areas where changes in climate have already and may in the future continue to influence food access. The chapter addresses the stability of food access, as well as adaptations for managing changing conditions.

## What Is Food Access?

Food access requires having the resources necessary to acquire nutritious foods. It involves food prices (trading), proximity to food, retail outlets (wholesaling/retailing) or farmable lands (producing), and social and cultural norms that shape intra-community and intra-household food distribution and food preferences.

The existence of food *(availability),* even in abundance, is not a guarantee of food security. The causes of internal U.S. food insecurity, for example, have been detailed extensively elsewhere (Gundersen et al. 2011, Takle et al. 2013, USDA ERS 2013a). U.S. domestic agricultural production was approximately 30% greater (according to regression) in 2013 compared with the mid-1990s (Figure 6.1); the United States produces approximately 3,900 kcal per person per day as of 2006 (USDA ERS 2014b)—well in excess of domestic demand. At the same time, U.S. food insecurity is 14.3% (Coleman-Jensen et al. 2014). This is primarily the result of household-level economic conditions, that is, *food access* (Figure 6.1), and exemplifies the limitations of high production alone as a means of managing food insecurity.

## 6.1 Influences on Food Access and Stability

A number of long-term trends affect global supply and demand for food commodities, which in turn influence food access (Trostle 2008). Climate's influence on food access occurs primarily through effects on food prices, trade and transportation networks, and wholesaling and retailing, each of which is discussed below.

Food access requires having the resources necessary to acquire nutritious foods.

### 6.1.1 Food Prices

A backdrop to any discussion of food *access* is the trend in real food prices over the last century (Figure 6.2).

The real food price—that is, the price of food adjusted for inflation (a measure of the price of food relative to all other prices)—generally decreased over the second half of the 20th century. Except for a sharp increase between 1972 and 1974, the real food price steadily declined from the early 1960s until 2000, when the price of food was near an historical low. Since 2000, however, the real food price has been on an upward trend. The global averages displayed in Figure 6.2 are useful; however, the variability displayed is extremely important to poorer households and regions, whose ability to purchase food is highly influenced by these types of changes, even when such changes are transitory (Hnatkovska and Loayza 2005, FAO 2011a, Minot 2012). The food crisis of 2008 was the result of a price spike brought on by multiple factors, including weather-induced crop failures in important global exporting regions, changes in demand patterns, and policy shifts in both importing and exporting nations that led to an overall closing of supply relative to demand, driving up prices and resulting in food riots in parts of the developing world (Bellemare 2014, Headey 2011, Nielsen and Vigh 2012, Trostle 2008). Price shocks can exacerbate other causes of food insecurity, including chronic poverty, disease, and a

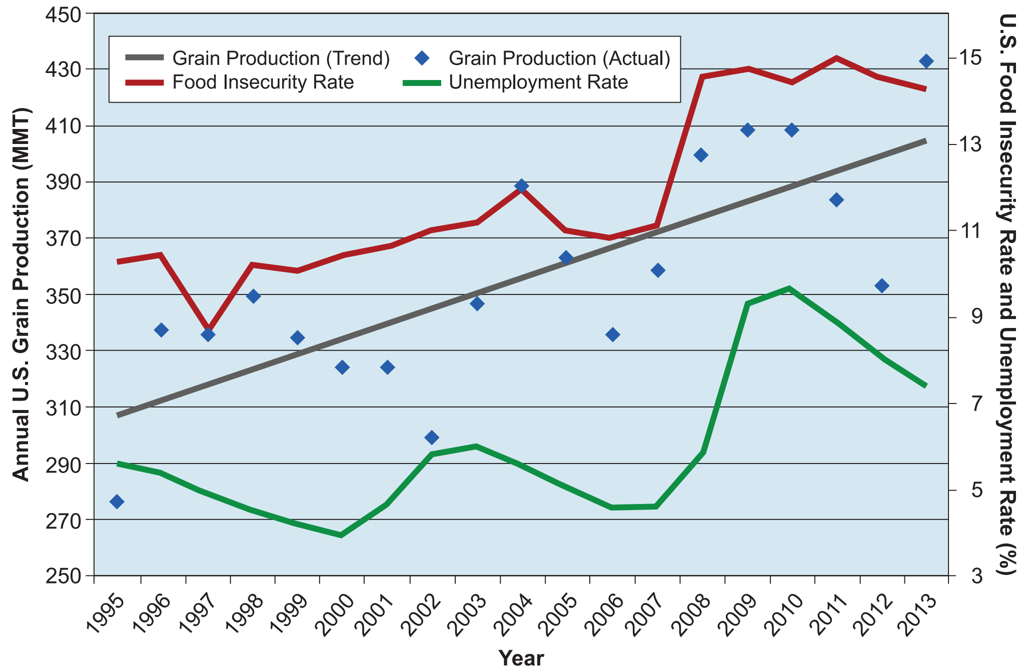


***Figure 6.1 Trends in U.S. grain production, food insecurity, and unemployment.*** *Food availability and production increases alone do not necessarily determine food-security status. For example, in this case, food insecurity is driven by economic conditions more than by food production. Sources: USDA ERS 1996–2013, USDA NASS 1997–2013, and USBLS 2014.*

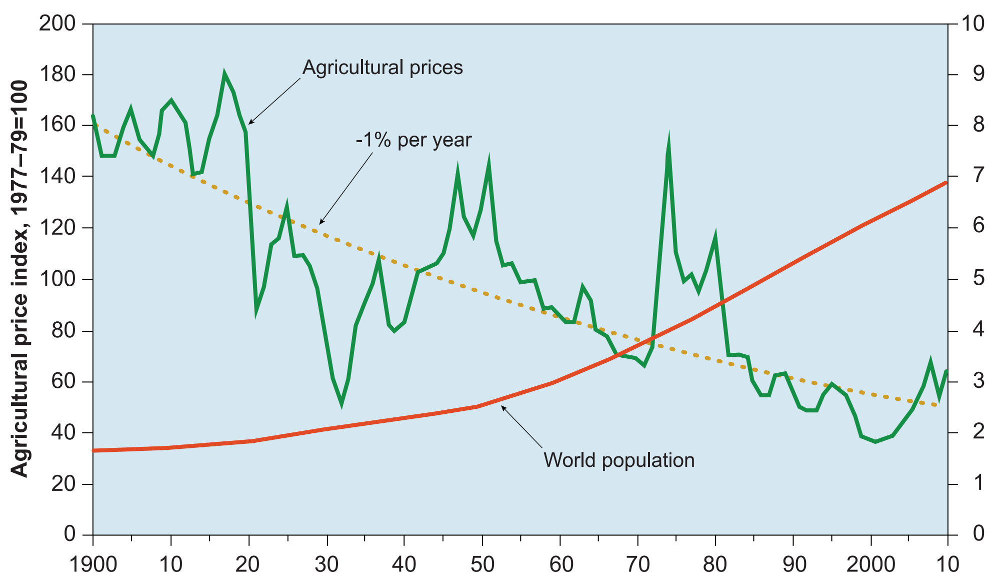


***Figure 6.2 Historical trends in real agricultural commodity prices and world population.*** *As world population growth has increased since 1900, the price of food adjusted for inflation has declined. Source: Fuglie and Wang 2012.*

lack of access to a nutritionally adequate diet (Irz et al. 2001, Thirtle et al. 2003, Ravallion et al. 2007, Schreiner 2012).

The concept of affordability integrates food prices with the amount of disposable income an individual or family has to spend on food. As a key element of food access, changes in food prices affect human well-being by shaping poverty outcomes, education outcomes, education and health services, and the reserves of productive assets held by the poor (Grosh et al. 2008). Low-income households, whose food budgets represent a large portion of their incomes, are potentially more vulnerable to price spikes than middle- and high-income households because they do not have the economic reserves to manage sudden or extreme increases in food prices (Bellemare 2014).

For poor populations, droughts, floods and other events that destroy housing, reduce agricultural production, or increase the cost of food are major factors in their impoverishment or remaining in poverty (Cutter et al. 2007), thereby limiting food *access*. Weather shocks, in particular, are a key source of vulnerability (Hansen 2002, IFAD 2011, Vermeulen and Campbell et al. 2012). Poor people have low resilience because they have few assets to fall back on when shocks occur (Jayne et al. 2003). When shocks do occur, poor people may resort to incurring debt, selling assets, or foregoing educational opportunities for their children—all of which are adaptive strategies that leave them more vulnerable to future shocks (Kinsey et al. 1998, Prince et al. 1999, IFAD 2011, Gazdar and Mallah 2013). Furthermore, poor farmers with small land holdings may be unable to adapt to climate change due to a lack of resources, lack of social standing, and marginalization (IFAD 2011).

Because of the nature of economic-growth processes, poorer countries typically grow at a faster rate than wealthier countries (Acemoglu 2008), and this trend is expected to continue. For the same reason, growth rates in newly middle-income countries are likely to be more moderate going forward than they have been in recent decades (particularly in China). Growth in income creates changes in consumptive demand, as described previously.

A number of variables interact to determine the balance between food supplies and demands. Aggregate grain and oilseed production rose on average 2.2% per year between 1970 and 1990 but has declined to about 1.3% since 1990, mostly due to slowing growth in crop yields (Fuglie and Heisey 2007, Fuglie et al. 2012). The demand for energy increases the cost of agricultural inputs such as fertilizers and fuel, and diverts crop use from feed stocks to biofuels. Global population is expected to grow to 8.6 billion in 2050 (UN 2012), with the sharpest increases in developing countries. The FAO (2009a) estimates that world food production would need to increase by 60%–100% by mass to feed a larger, wealthier, and more urban population.

The combined effect of slowing growth in agricultural production *(availability)* and an increasing demand for food is higher food prices (Mankiw 2011). In many countries, economic access to food will benefit from increases in per-capita income (Mankiw 2011). If the rise in incomes surpasses the rise in food prices, overall access to food, even in developing countries and regions, can be expected to improve. However, higher food prices affect everyone, and some less developed countries may not experience a rise in per-capita income due to various obstacles to growth; in such cases, higher prices may cause a reduction in food access for large segments of the population. For example, while global yields grew by 2.4% annually between 2003 and 2012, this growth has been nearly matched by increased demands for cereals (Funk and Brown 2009). If population and economic growth double cereal demands between 2005 and 2050 (Tilman et al. 2011), and climate change slows yield growth (Porter et al. 2014), then overall access will be diminished.

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The volatility of global food prices *(stability)* has been increasing in recent years due to a combination of factors, including the widespread occurrence of extreme climate events (e.g., droughts), competition for land by fuel crops, and a change in the commodity markets as global demand for commodities from nonfood sectors increases (Bellemare et al. 2013, Haile and Kalkhul 2013).

### 6.1.2 Trading and Transporting Food

Trade in agricultural commodities and food can reduce price volatility and enhance predictability *(stability)* for both producers and consumers by integrating markets (OECD 2013). Unintended consequences can ensue from policy interventions, as illustrated by the 2008 food price crisis (Slayton 2009).

Damages to the transportation infrastructure that enables trade diminish food access for both consumers who have greater difficulty obtaining food and also for producers, who have fewer available options to sell their crops (Chamberlin and Jayne 2013). Current weather anomalies offer a preview into the possible effects of climate change on the transportation infrastructure that enables trade. These events influence food access by hindering food's movement from its place of production to consumers, altering the price of food in response to changes in the price of transportation and disrupting the timing and operation of logistical supply systems (IPCC 2012). Extreme temperatures can physically damage roadways and railways (Nemry and Demirel 2012). Heavy rainfall, sea-level rise, and storm surges can damage ground transportation and shipping infrastructure in coastal and low-lying areas (Schweikert et al. 2014). Severe drought can disrupt barge shipping in rivers when water levels get too low (Changnon 1989, Yu and Fuller 2005).

Extreme temperatures, storm surge, river floods, and other types of extreme weather physically damage transportation infrastructure and the supply chain (Koetse and Rietveld 2009, Becker et al. 2013). For example, in 2012, Hurricane Sandy led to a week-long shutdown of one of the largest container ports in the United States, generating economic damages estimated as high as USD 66 billion (Blake et al. 2013). Low water levels in rivers and lakes force inland waterway vessels to use only part of their maximum capacity, which leads to an increase in shipping costs and the number of trips they must make (Attavanich et al. 2013, Jonkeren et al. 2014, Millerd 2005 and 2011). In the United States, Attavanich et al. (2013) estimate that lower water levels in the Great Lakes, across which many goods (bulk freight, including agricultural products) are transported by barges, reduce the ability of U.S. farmers to export their grain to international markets. These transportation changes will affect both the ability of farmers to get their goods to market as well as the access of consumers to the goods.

### 6.1.3 Wholesaling and Retailing Food

With increased urbanization has come the rise of supermarkets and other highly efficient retail outlets in developing countries.

Food for consumption is sold to distributors for onward sale through large supermarkets, small vendors, or directly to consumers. Infrastructure is susceptible to damage from climate and weather, and through the influence of climate on economic drivers by affecting consumer traffic or increasing local demand during times of crisis (Burrus et al. 2002, Murray et al. 2010). More than half of the world's population lives in urban areas (Seto et al. 2012). With increased urbanization has come the rise of supermarkets and other highly efficient retail outlets in developing countries (Reardon et al. 2003, Pingali 2007). In coastal cities, imported food that caters to changing urban dietary preferences competes with food supplied by inland producers (Pingali 2007). Capital-intensive and labor-intensive production systems frequently coexist in developing economies, and most agrifood sectors include food from both. The result is a diverse exposure to climate and weather shocks, for which the retail sector has increasingly assigned risk to the producer (Lee et al. 2012).

Expansion of large-scale retailing will also affect producer prices as integration and consolidation occur, particularly for specialty crops such as cocoa and coffee (Kaplinsky 2004). Both high and low food prices on the world market challenge food security (Swinnen and Squicciarini 2012). Low prices, underpinned by producer subsidies in North America and Europe, make it difficult for farmers in developing countries to compete with farmers in developed countries on the world market, thus reducing the former's domestic capacity (Anderson et al. 2013). Alternatively, high prices make it difficult for low-income populations to purchase adequate food supplies when their own food production cannot meet their needs (Nin-Pratt et al. 2011).

## 6.2 Adaptation for Food Access and Stability

The effects of climate and food price changes depend upon vulnerability; the ability to effectively respond to shocks depends on adaptive capacity, which varies greatly within and across societies. The future evolution and distribution of vulnerability and adaptive capacity will strongly influence the effects of climate change on food access (Dunford et al. 2015, Krishnamurthy et al. 2014).

With respect to climate change, the adaptive capacity of the food system depends upon how effectively risk is managed to minimize its effects on the overall supply chain. Risk and uncertainty take many forms in the food chain: weather and climate, biological processes critical to successful production, financial risk, geographical separation of production and consumption, market cycles, and the political economy of food systems (Krishnamurthy et al. 2014, Vermeulen and Campbell et al. 2012). The degree to which different aspects are sensitive is very case-specific (Johnson and Brown 2014, Murphy et al. 2012, Cole et al. 2009). In some situations, a severe storm can destroy crops in the field and hence lead to local food shortages and price increases. More-widespread food insecurity may arise if a larger region depends on a critical element of infrastructure (e.g., rail) that can be destroyed by a major flood. Although it is not possible to pinpoint a specific risk to the food system from climate change that applies universally, the interdependence of different food-system activities means that effects on post-farm-gate activities can outweigh farm-level production effects (Rosenzweig et al. 2001).

Food prices are affected by access to markets and by trade decisions. In an extension of previous AgMIP research, five global economic models extend their analysis to look at the effects of trade (Wiebe et al. 2015). Four scenarios drawn from this work are shown in Figure 6.3. Scenarios 1 and 2 assume relatively low emissions (RCP 4.5) and high levels of international cooperation in adapting to and mitigating climate change (SSP1). Scenarios 3 and 4 make the opposite assumptions: high emissions (RCP 8.5) and low levels of international cooperation in adapting to and mitigating climate change (SSP3). Each scenario differs in its assumptions regarding trade. Scenario 1 assumes moderate levels of global trade, Scenario 2 assumes freer trade, Scenario 3 assumes very restricted trade, and Scenario 4 assumes restricted trade, but trade that is less restricted than under Scenario 3.

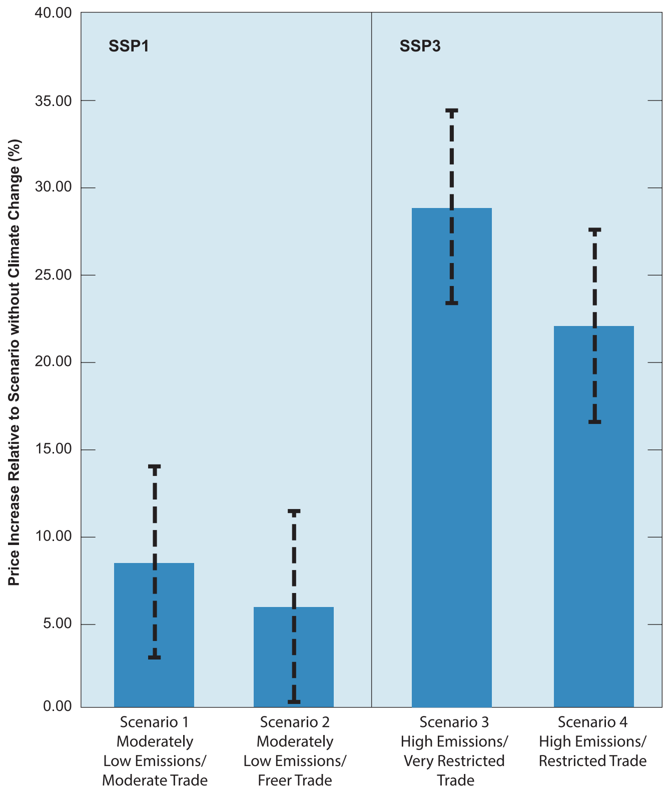


***Figure 6.3 Projected mean food price changes in 2050.*** *Food prices from five global model projections for four scenarios, with error bars representing the uncertainty in results. The scenarios depicted here are relative to a projected 2050 baseline price when climate conditions are held constant at current levels. Scenario 1 projects moderately low emissions (RCP 4.5) and moderate levels of trade. Scenario 2 also projects moderately low emissions, but with freer trade than Scenario 1. Scenario 3 projects high emissions (RCP 8.5) and very restricted trade. Scenario 4 projects high emissions with restricted trade, but trade that is less restricted than under Scenario 3. All scenarios demonstrate increased prices under climate change. Freer trade results in smaller projected price increases for both low emissions (Scenario 2) and high emissions (4) scenarios. Adapted from Wiebe et al. 2015*

Relative to a world where the climate remains fixed under current conditions, the low-emissions/ high-international-cooperation scenarios (1 and 2) exhibit smaller price increases compared with the high-emissions/low-international-cooperation scenarios (3 and 4); however, prices do increase in each case relative to a scenario where current climate conditions remain constant until 2050 (a "no climate change" scenario). The freer-trade scenarios (2 and 4) result in lower price increases relative to the restricted-trade scenarios (1 and 3).

The scenarios are limited in that they are based on models that primarily represent production of major agricultural grain commodities and do not fully characterize the food system beyond the farm gate, thereby missing important food system elements that affect food access. They also represent consumer behavior in relatively simple terms, with highly aggregated data that do not fully reflect some demographic changes or changes in the distribution of income. Yet, the influence of climate change to increased prices, regardless of socioeconomic scenario, is consistent.

The opportunities of a more resilient food chain depend upon location and product (Kaplinsky 2004, Lee et al. 2012). Participation in agricultural markets is often uncertain, risky, and conducted on unfavorable terms for smallholders in rural areas (IFAD 2011). There is a positive relationship between average farm size and the level of economic development: the higher the per-capita GDP of a country, the larger the average farm size (Eastwood et al. 2010) and the greater the adaptive capacity (Brooks et al. 2005). Differences in adaptive capacity can drive households to grow their own food instead of buying it at local markets or to limit their production to market-oriented crops (Nin-Pratt et al. 2011). If remunerative and reliable produce markets are available, farm households can increase their incomes and reduce their vulnerability during poor production years (Lloyd et al. 2011), though the risks of market participation are context and value-chain specific (IFAD 2011, Zant 2013, Haile and Kalkhul 2013). However, it is generally a challenge for poor rural people to seize rewarding opportunities in produce markets and cope well with the attached risks (Reardon et al. 2003, Neven et al. 2009).

The capacity of the urban poor to adapt to changes in climate and consequent effects upon food access

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depends on many factors. Climate change is one stress among many that cities face (Leichenko 2011). Cities in many places often have common vulnerabilities that can be ameliorated with adaptive responses operating at different scales, such as engineering solutions to floods, waste management, and disaster planning (UNISDR 2004, Cutter et al. 2007, Shepherd et al. 2013). The urban poor, however, have the greatest exposure to flooding, high temperatures, and other hazards likely to occur with a changing climate (Douglas et al. 2008). Better understanding of the relevant interactions between urban development and the climate system, and turning the hazards resulting from human pressures into sources of opportunities and innovations, is indicated for improved food-access outcomes in urban settings (Romero-Lankao and Dodman 2011).

For wholesaling and retailing activities, adaptation might take a number of forms. Adaptation to higher temperatures may be accomplished with increased refrigeration, though that would likely come at increased costs for industry (James and James 2010). Disruptions in delivery systems due to extreme events also may also require adaptive adjustments. “Just-in-time” logistical systems, which match the rate of food production to the rate of food consumption to avoid the need for large storage areas and maintenance, may be at greater risk under more-severe climate extremes, though it appears possible that adaptive measures, such as greater supply-chain redundancy, may be one possible approach (Stecke and Kumar 2009, Altay and Ramirez 2010). Repairs, modifications, changes to shipping logistics, and transportation substitutions (e.g., switching from barge to rail transport) may be applied to a greater degree, as well, to adapt to changing conditions (Brown et al. 2013, Rodrigue 2013).

## 6.3 Measuring Food Access and Stability

The measurement of food access generally focuses on economic access using price and income information (Deaton 1989). However, it is difficult to track basic food prices on a global scale (Brown et al. 2012). Data issues are compounded by social norms that are frequently geographically specific and cannot be easily applied to other locations.

Information on household and intrahousehold access to food can be combined with per-capita food-consumption statistics to develop national-level measures of undernourishment, such as those found in the FAO’s Prevalence of Undernourishment Indicator (FAO 2014c). No comparable indicator is available for access to nutrients, though some information can be gleaned from dietary composition, as assessed by food-intake data.

Because of the heterogeneity of food items, and because access depends on cost, the real rate in the growth of food supply is typically measured in monetary terms. A money metric for real growth involves correcting for price variation over time (i.e., changes in the general price level) within a country and for differences in exchange rates and purchasing power across countries. To account for these factors, international food-production statistics are usually expressed in terms of a reference currency (e.g., the U.S. dollar, or USD). For instance, FAO data on the value of food production currently use average producer prices for each product and country for the period 2004–2006 as converted into USD at purchasing power parity (PPP) conversion rates (FAO 2014d). Income statistics in PPP dollars are also available from the United Nations (UN) International Comparison Program and included in the World Bank’s World Development Indicators (World Bank 2014). Indicators of monetary access to food based on these or other figures, however, are not currently available, except for some specific places and times. The closest substitutes are poverty rates, which measure the purchasing power of households relative to the cost of covering their food requirements and other basic needs (Deaton and Dupriez 2011).

A compilation of survey-based income and consumption distributions across households is maintained by the UN University as part of the

WIDER-WIID project (Chotikapanich et al. 2007). The measurement of income and consumption distributions across households requires estimating the mean and variance of the distribution of per-capita household income. Income variance data are usually taken from household income or expenditure surveys; average income data may be taken from the same surveys (which usually involve some underreporting of income) or from national sources (which also suffer from measurement error). In either case, the indicator is not restricted to food but rather covers all expenditures, although many surveys now specifically collect detailed data on food expenditures (Deaton 1997).

## 6.4 Conclusions and the Future

Climate change presents challenges to food access and its stability in a highly connected world. This section addresses lessons and conclusions about the future of food access and its stability, based on the available literature. Subsection 6.4.1 below combines information from the rest of this chapter with the shared socioeconomic pathways described in Chapter 3, allowing the report's authors to identify sensitivities under climate change given a range of development pathways.

*Price*

Food-access stability depends on relatively stable climatic conditions. Changes in the occurrence of weather and climate extremes are already detectable in many regions (Zhang et al. 2011, Coumou and Rahmstorf 2012, Donat et al. 2013, Zwiers et al. 2013, Coumou and Robinson 2013), and a higher frequency of very hot days, very dry days, intense rainfall, and changes in the growing season can occur even under lower-emissions scenarios (Tebaldi et al. 2006, Kharin et al. 2007, Wuebbles et al. 2014, Menzel et al. 2003, Robeson 2002), which can affect food prices.

There is high uncertainty about future real food prices, even in the absence of climate change (Figure 6.2). Some models project substantial price increases, while others project substantial price decreases, each in the absence of climate-change effects. The addition of climate change to those projections increases prices in either case (Figure 6.3), however, implying that climate change is likely to diminish gains in food access that might be achieved under any socioeconomic-development scenario.

Rapid increases in food prices due to extreme events are more likely in the future and have been demonstrated to reduce food affordability and consumption (Webb 2010). Low-income households, for whom food represents a larger portion of income, are more vulnerable to price spikes than middle- and high-income households (Bellemare 2014).

Food allocation among different groups (e.g., ethnic, gender) can also be affected by changes in food prices, resulting in increased vulnerability to food insecurity by more marginalized segments of a population (Raleigh 2010).

Food-price increases are most likely to affect segments of the growing population with lesser capacities to absorb food shortages, even over short periods of time, potentially increasing the prevalence of transient food insecurity, particularly in the absence of increased incomes (Becquey et al. 2012, Hillbruner and Egan 2008, Handa and Mlay 2006).

*Trade and Transportation*

Trade of agricultural commodities in a changing climate, and the physical transportation system that enables that trade, can alter vulnerability to changes in food access. Effects are context-specific, and changes in large-scale average conditions depend greatly upon actions and choices made outside the food system itself.

Trade can allow greater food access through a more diffuse supply base, stabilizing food prices and compensating for regional shortfalls (Schmidhuber and Tubiello 2007). Food trade can also expose import-dependent communities to changes in climate occurring in distant regions through supply disruptions and price fluctuations (Godfray and Beddington et al. 2010).

Increased food prices can benefit the agricultural producers who generate a surplus (Swinnen and Squicciarini 2012). However, price variability can create food-access difficulties for food producers, even when prices are on average increasing, due to the greater challenges in managing uncertain and fluctuating income levels (Brown et al. 2009). The frequently low production levels of food-insecure populations reduce the ability of these populations to benefit from a productive agriculture sector elsewhere (Brown et al. 2009). These concerns are particularly acute where population growth outstrips food production and imports become increasingly necessary using scarce foreign capital (Alexandratos and Bruinsma 2012). Population expansion and urbanization are projected to continue through the 21st century, particularly in lower income regions (Ezeh et al. 2012); thus, the need for imports is likely to increase (Godfray and Garnett 2014, Masters et al. 2013).

Damage to transportation infrastructure can diminish food access for consumers as it becomes more difficult to obtain food (Kneafsey et al. 2013) but also for producers who have fewer available options for selling their crops (Emran and Hou 2013). Repairs, modifications, changes to shipping logistics, and transportation substitutions (e.g., switching from barge to rail transport) can improve food access (Omamo 1998, Koetse and Rietveld 2009). Increased refrigeration during transport can keep food unspoiled but increases costs (James and James 2010). The smaller the changes in climate, the lower the costs are likely to be.

*Wholesaling and Retailing*

Food wholesaling and retailing plays an important role in the provision of food to consumers (Ericksen 2008). This sector is undergoing expansion in the form of supermarkets in much of the developing world, alongside more traditional systems, driving an evolution in procurement systems to source foods from long distances (Reardon et al. 2003). Such structural changes within the sector expose it to climate risks (Crush and Frayne 2011, Lee et al. 2012). Contract farming, purchasing agreements, and continued expansion of supermarket-type wholesaling and retailing are expected to continue and form an important backdrop for any effects that changes in climate may have (Barrett et al. 2012, Collier and Dercon 2014).

The rapidity of adaptive changes in the sector will be affected by changing climate effects upon trade and transportation systems and vulnerabilities along the supply chain, particularly under higher-emissions scenarios over the longer term and operating in tandem with changes in consumptive demand. The nature of these changes can only be fully understood by working in cooperation with industry, which is a fundamental food system actor, but whose internal data, metrics, and indicators are not often available for peer-reviewed analysis to inform this discussion.

| Shared Socioeconomic Pathway | Price | |
|---|---|---|
| | P | W |
| SSP1 | | |
| SSP2 | | |
| SSP3 | | |
| SSP4 | | |
| SSP5 | | |

(P: poorer nations, W: wealthier nations)

| Key |
|---|
| Low Risk |
| Medium/Low Risk |
| Medium Risk |
| High Risk |
| Very High Risk |

***Figure 6.4 Relative risks to food access for different SSPs.*** *The risks to food access would be lowest under the economic conditions described in SSP1 and SSP5, with poorer nations at higher risk across almost all food affordability and allocation categories for all SSPs. Shading represents higher or lower risks for each SSP from climate change. Risks reflect the informed judgment of the authors of this report, based on the available literature.*

### 6.4.1 Food Access and Stability in the Context of Shared Socioeconomic Pathways (SSPs)

The influence of climate change upon food access and its stability depends on responses by each of the key food-system elements under differing socioeconomic trajectories. Food access is shaped by prices and affordability, trade and transportation, and wholesaling and retailing. Each of these factors is highly context-specific. Many parts of the food system are not considered by the SSPs or within available modeling frameworks directly, but applicable lessons emerge from the exercises that have been conducted. For these reasons, this section focuses on price as a principal shaper of future food access, considered for each of the SSPs introduced in section 3.4.1 of this volume. Trade significantly influences food prices, but anticipated effects of climate change on trade were discussed in detail in Chapter 5 (section 5.4.1) and are not reiterated here. Figure 6.4 reflects the informed judgment of the report's authors on the relative risks that contribute to food access and stability for each of the five SSPs.

Under SSPs 1 and 5, the existence of highly connected trade networks suggests that climate change is unlikely to generate exceptional price shocks that might widely compromise food access and stability. Under both scenarios, markets effectively facilitate the movement of food from areas of food surplus to areas of food deficit, helping to ameliorate high food prices and price shocks. Additionally, both SSPs anticipate substantial economic growth that would improve purchasing power and make food more affordable, in both poor and wealthy contexts. The fossil-fuel-intensive pathway of SSP5, however, could result in significant climate disruptions to transportation networks and create barriers to trade, diminishing some of these benefits, particularly in poorer countries where resources to invest in infrastructure improvements and repairs are scarce. It is therefore possible that under SSP5, climate change could make food less affordable for people in poorer countries.

Constrained trade under SSPs 2, 3, and 4 has price, and therefore food-access, implications. SSP2 would likely lead to many stresses and shocks, and while the semi-open globalized economy may allow for trade links that prevent severe price shocks and affordability challenges in this SSP, it may not be open enough to facilitate the robust trade links needed for markets to effectively respond to the more severe shocks. Under SSP2, it is likely that price increases would be more prevalent in poorer countries. Under SSPs 3 and 4, this pattern and outcome are accentuated. These SSPs present a world where the wealthy enjoy strong connections but are disconnected from the global poor, who are disconnected from one another in different geographic locations. As a result, markets would rarely respond to food shocks and stresses such that food can effectively move into deficit areas to address shortages and higher prices. Under SSP3, ineffectual trade connections can also exist among the world's wealthy, potentially compromising food prices and affordability, though these effects would almost certainly be less severe than among poorer nations. Food prices and affordability would be at risk in all SSPs, but SSPs 2, 3, and 4 exhibit the greatest risks to food access and its stability.